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Indian Standard
SPECIFICATION FOR GENERAL PURPOSE GLASS THERMOMETERS
PART II ENCLOSED-SCALE THERMOMETERS
(Second Revision)

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Indian Standard
SPECIFICATION FOR GENERAL PURPOSE GLASS THERMOMETERS
PART II ENCLOSED-SCALE THERMOMETERS
(Second Revision)

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Indian Standard

SPECIFICATION FOR GENERAL PURPOSE GLASS THERMOMETERS

PART II ENCLOSED-SCALE THERMOMETERS

(Second Revision)

0. FOREWORD

0.1 This Indian Standard (Part II) (Second Revision) was adopted by the Indian Standards Institution on 30 January 1982, after the draft finalized by the Laboratoryware and Related Apparatus Sectional Committee had been approved by the Chemical Division Council.

0.2 This standard was first published in 1964 under the title 'Solid-stem general purpose glass thermometers' and was revised in 1973. However, in view of the experience gained during the years in the fabrication and use of thermometers and publication of international standards on the same subjects by the International Organization for Standardization (ISO), the Committee responsible for the preparation of the standard decided to revise it. In this revision, accordingly, the standard has been prepared in two parts. Part I covers solid-stem type and Part II now covers enclosed scale type thermometers which were previously not covered in the standard. Part II is based on ISO/1771-1981, 'Enclosed-scale general purpose thermometers' and, in addition, covers partial immersion thermometers not covered in the ISO document.

0.3 This standard contains clause **6.2**, which calls for agreement between the purchaser and the supplier.

0.4 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test, shall be rounded off in accordance with IS : 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

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*Rules for rounding off numerical values (*revised*).

1. SCOPE

1.1 This standard (Part II) prescribes the requirements for enclosed-scale general purpose liquid-in-glass thermometers graduated for vertical total and partial immersion, covering the overall range − 100° to 500°C.

2. TERMINOLOGY

2.0 For the purpose of this standard, the following definition in addition to those given in IS : 2627-1979* shall appy.

2.1 Schedule Mark — It is the number corresponding to the serially arranged total or partial immersion thermometers in col 1 of Table 1, followed by letters 'TI or PI' [*see also* **6.1** (d)].

3. TYPE

3.1 The thermometers shall be of the liquid-in-glass enclosed-scale type.

4. CALIBRATION AND IMMERSION

4.1 The thermometers shall be calibrated in degrees celsius, for vertical total or partial immersion.

NOTE — Partial immersion thermometers are very convenient to use when the ambient temperature in the calibrating laboratory is identical with that of the place of their use. If this condition is not obtained, these thermometers require a far more complicated correction than the total immersion thermometers (*see* IS : 6274-1971†). As such, in general the use of partial immersion thermometers should be made with due discretion.

5. REQUIREMENTS

5.1 Materials

5.1.1 *Glass* — The thermometer bulb shall be made of suitable thermometric glass. The glass or glasses comprising the thermometer shall be so selected and processed that the finished thermometer shows the following characteristics:

a) Stress in the glass shall be reduced to a level sufficient to minimize the possibility of fracture due to thermal or mechanical shock,

b) The bulb glass shall be stabilized by a suitable heat treatment to ensure that the accuracy requirements of **5.6** are met,

c) The legibility of the reading shall not be impaired by devitrification or clouding, and

d) The image of the meniscus shall be distorted as little as possible by defects or impurities in the glass.

---

*Glossary of terms relating to liquid-in-glass thermometers (*first revision*).

†Method of calibrating liquid-in-glass themometers.

TABLE 1 DETAILS OF DIMENSIONS OF ENCLOSED-SCALE GENERAL PURPOSE GLASS THERMOMETERS

(*Clauses* 2.1 *and* 5.2)

Bulb Length — 10 to 25 mm
Bulb Diameter — not greater than stem diameter
Stem Diameter — 7 to 12 mm

SCHEDULE MARK (1)	MAIN SCALE (2)	GRADUATION INTERVAL (3)	LONGER LINE AT EACH (4)	FRACTIONAL FIGURING AT EACH (5)	FULL FIGURING AT EACH (6)	OVERALL LENGTH, *Max* (7)	LENGTH OF MAIN SCALE (8)	DISTANCE FROM BOTTOM OF BULB TO START OF MAIN SCALE (9)
°C	°C	°C	°C	°C	°C	mm	mm	mm
1.	−100 to +30	1	5	—	10	305	180	60
2.	−50 to +50	0·5	1	5	10	305	180	60
3.	−35 to +30	0·5	1	5	10	305	180	60
4.	0 to 60	0·5	1	5	10	305	180	60
5.	0 to 100	0·5	1	5	10	305	180	60
6.	0 to 100	1	5	—	10	305	180	60
7.	0 to 160	1	5	10	100	305	180	60
8.	0 to 200	1	5	10	100	305	180	60
9.	0 to 250	1	5	10	100	325	200	60
10.	0 to 360	1	5	10	100	350	225	60
11.	0 to 360	2	10	20	100	305	180	60
12.	0 to 500	5	10	50	100	305	180	60

NOTE — Except for thermometer having schedule marks 1 and 2, all the rest shall be made for partial immersion also by increasing the dimensions in col 7 and 9, depending upon the immersion required. For schedule marks 1 and 2, partial immersion is not permitted (*see* Note in **4.1**).

5.1.2 Thermometric Liquid

5.1.2.0 The thermometric liquid shall be entirely free from contamination, particularly of solid particles or of any liquid which produces a variation in volume with time.

5.1.2.1 Recommended thermometric liquids and the approximate temperature ranges covered by them are given blow:

Thermometric Liquid	*Approximate Temperature Range, °C*
Mercury	−38 to +600
Mercury-thallium alloy [8·5 percent (m/m) of thallium]	−55 to +600
Alcohol	−80 to +50
Toluene (IS : 537-1967*)	−90 to +50
Technical pentane	−200 to +30

5.1.2.2 When organic themometric liquids are used, a suitable dye shall be added to facilitate easy reading of thermometers.

5.1.2.3 When alcohol is used, it shall comply in all respects with the provisions of special Grade of IS : 321-1964†, subject to the following modifications:

a) *Aldehydes and ketones* — Alcohol shall not contain more than 0·02 percent (m/m) of aldehydes and ketones, calculated as acetaldehyde (CH_3 CHO); and

b) *Amines* — Alcohol shall give no indication of the presence of amines when tested by adding to 10 ml of alcohol, 10 ml of distilled water followed by two drops of a saturated solution of *o*-nitrophenol in water. Not more than 0·05 ml (1 drop) of 0·1 *N* sulphuric acid shall be required to discharge any yellow colour produced.

5.1.3 *Gas Filling* — All thermometers intended for use above 250°C shall be filled with a dry inert gas, preferably nitrogen, above the liquid column.

NOTE — The pressure of gas should be high enough to raise the boiling point of the thermometric liquid sufficiently to ensure that reliable readings are obtained over the complete thermometer scale.

---

*Toluene pure, nitration grade (*first revision*).

†Specification for absolute alcohol (*revised*).

5.2 Construction

5.2.1 *Shape* — The thermometers shall be straight. Their external cross-section shall be approximately circular.

5.2.2 *Top of Thermometer* — The top of the thermometers may be finished with a glass ring, the diameter of which shall not exceed that of the stem. If a finish other than a ring is provided, its diameter shall not exceed that of the stem. The top of enclosed-scale thermometers may in addition be provided with a metal or plastic cap cemented to it with or without a ring, button or hook (*see* Fig. 1 and 2).

5.2.2.1 In the case of ringtop finish, the ring shall be in a plane at right angle to the line of sight when reading the thermometer.

5.2.3 *Capillary Tube* — The inside of the capillary tube shall be smooth.

5.2.3.1 The cross-sectional area of the bore shall not show variation greater than 10 percent of the average value, except at the bulb and the expansion and contraction chambers, if provided.

5.2.3.2 The size of the bore shall be such that when the temperature is rising very slowly, at a uniform rate, the jumping of the meniscus of the thermometric liquid does not exceed one-half of the smallest scale division.

5.2.4 *Strip Bearing the Scale* — The strip bearing the scale shall be of a translucent material suitable for the temperatures to be measured. It shall be placed tightly against the capillary tube inside the sheath and shall be firmly and securely fastened at the top of the thermometer, in such a way that it can freely expand in length (*see* Fig. 1).

5.2.5 *Expansion Chamber* (*Safety Chamber*) — An enlongated or pear-shaped expansion chamber (*see* Fig. 1) having hemispherical top and pointed downwards shall be provided at the top end of the capillary tube in alignment with the bore.

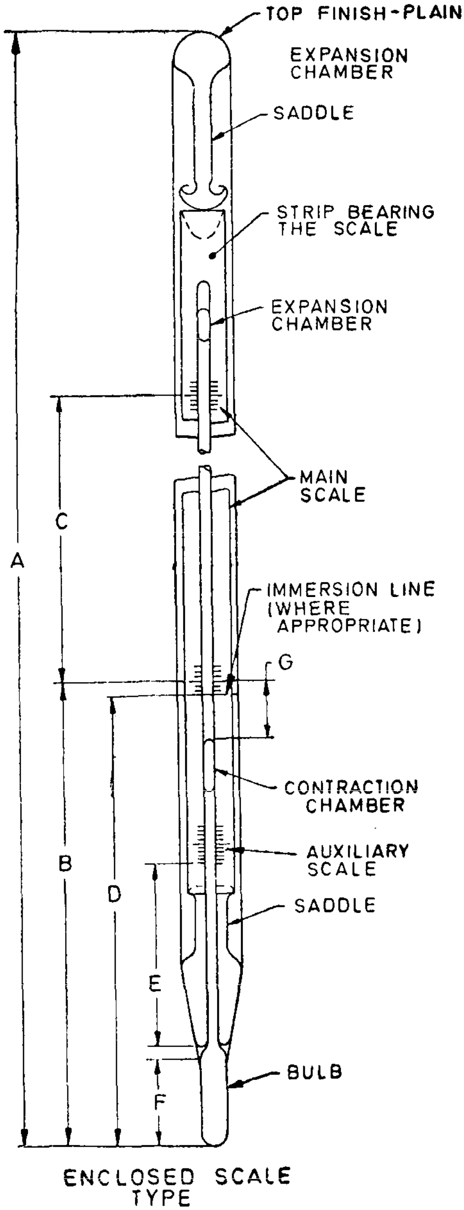
5.2.5.1 The volume of space above the scale, including the expansion chamber, shall be equivalent to at least that occupied by an interval of 50 smallest divisions in the scale.

NOTE 1 — A gas filled thermometer should not be heated above its maximum nominal range, as even a short duration of overheating is likely to shift the zero (fiduciary) point and the scale by an uncertain amount and a recalibration may, therefore, become necessary.

NOTE 2 — For testing the requirement of the expansion chamber, one percent of thermometers, subject to a minimum of one, shall be taken.

5.3 Graduation and Figuring

5.3.0 *General* — The main as well as the fiduciary scale, where provided, shall have the same graduation interval.



A	Total Length	*E*	Top of Bulb Funnel to Lower Nominal Limit of Auxiliary Scale
B	Distance from Bottom of Bulb to Lower Nominal Limit of Scale	*F*	Bulb Length
C	Scale Length	*G*	Top of Contraction Chamber to Lower Nominal Limit of Main Scale
D	Depth of Immersion		

FIG. 1 GENERAL DESIGN AND TERMINOLOGY OF LIQUID-IN-GLASS THERMOMETERS

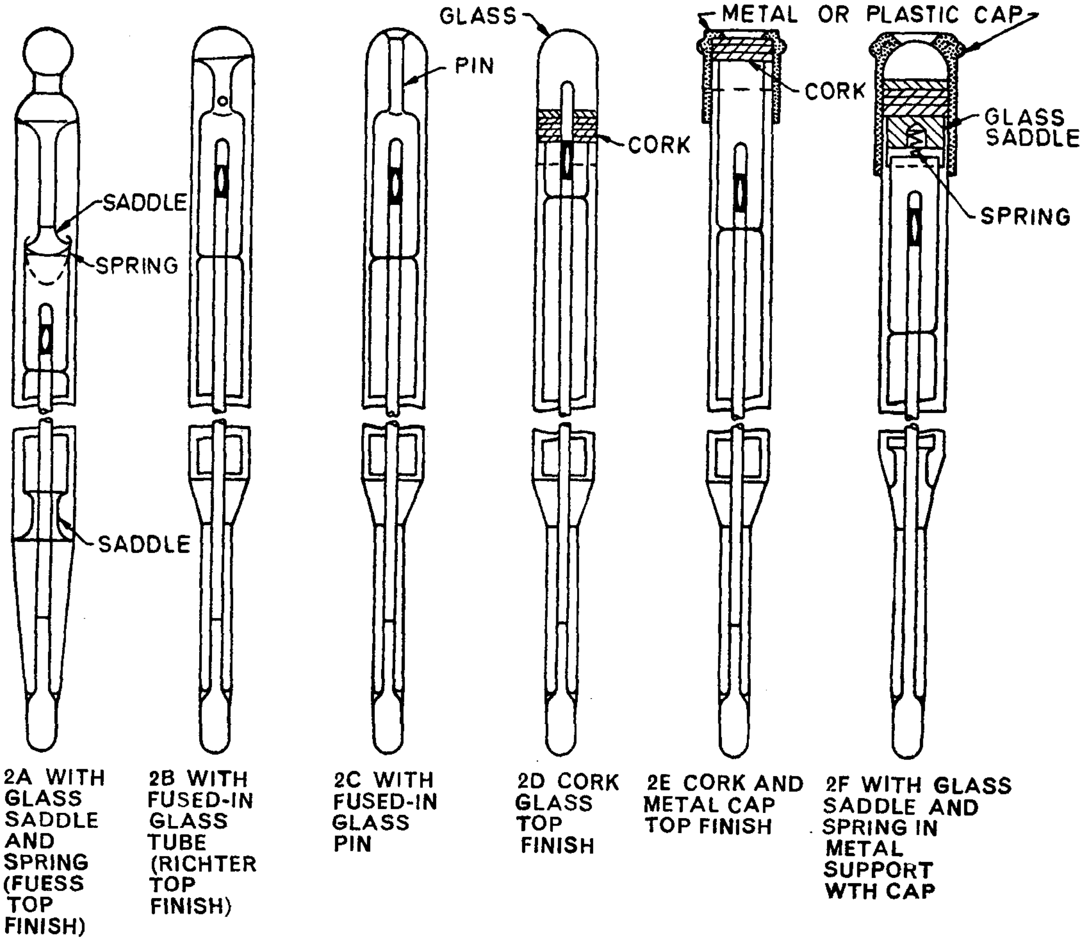

GLASS
METAL OR PLASTIC CAP
PIN
CORK
CORK
GLASS SADDLE
SADDLE
SPRING
SPRING
SADDLE
2A WITH GLASS SADDLE AND SPRING (FUESS TOP FINISH)
2B WITH FUSED-IN GLASS TUBE (RICHTER TOP FINISH)
2C WITH FUSED-IN GLASS PIN
2D CORK GLASS TOP FINISH
2E CORK AND METAL CAP TOP FINISH
2F WITH GLASS SADDLE AND SPRING IN METAL SUPPORT WTH CAP

Fig. 2 Top Finishes and Method of Fixing the Strip Bearing the Scale of Enclosed-Scale Thermometers

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5.3.0.1 The main scale shall extend beyond the maximum and minimum nominal temperatures by minimum of 5 divisions.

5.3.1 *Graduation Lines*

5.3.1.1 Graduation lines shall be at right angles to the axis of the thermometer when the thermometer is viewed from the front in a vertical position. Each type of line shall finish on an imaginary line parallel to the axis.

5.3.1.2 The graduation lines shall be clearly etched on the strip and filled with black pigment or marked permanently. They shall be of equal and uniform thickness which shall not exceed one-fifth of the graduation interval (the axial distance between the centres of two consecutive lines) and they shall not exceed 0·2 mm in thickness.

5.3.1.3 If e is the graduation interval and d, the width of the scale strip, the relationship shall be as follows:

a) Thickness of graduation line, 0·2 e, but not exceeding 0·2 mm.

b) Length of short graduation line, a, 0·4 c, but more than the diameter of the capillary tube.

c) Length of medium graduation line, b, 0·6 c

d) Length of long graduation line, c, 0·8 d.

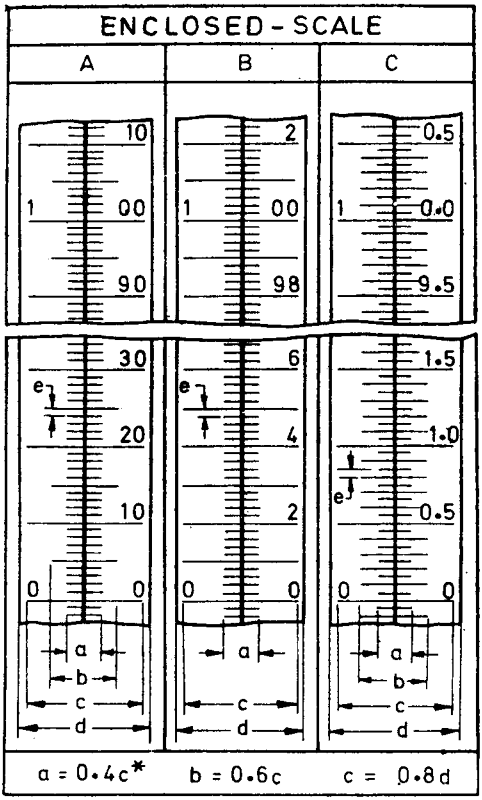
5.3.1.4 One of the following three patterns of graduation shall be used for graduating thermometers according to the smallest scale division of the thermometer (*see* Fig. 3).

a) If the smallest scale division reads 1·0°C, then:
   1) every tenth graduation line shall be a long line,
   2) there shall be a medium line midway between two consecutive long lines,
   3) there shall be four short lines equally spaced between consecutive medium and long lines (*see A* in Fig. 3).

b) If the smallest scale division reads 2·0°C, then:
   1) every fifth graduation line shall be a long line, and
   2) there shall be four short lines equally spaced between two consecutive long lines (*see B* in Fig. 3).

c) If the smallest division reads 0·5 or 5·0°C, then:
   1) every tenth graduation line shall be a long line,
   2) there shall be four medium lines equally spaced between the two consecutive long lines, and

3) there shall be one short line midway between two consecutive medium lines or between consecutive medium and long lines (*see C* in Fig. 3).



Graduation Interval = *e* mm

Thickness of graduation lines = 0·2 *e* but not exceeding 0·2 mm

Graduation Type A Smallest scale division 0·01, 0·1, 1 or 10°C (1°C shown)

Graduation Type B Smallest scale division 0·02, 0·2 or 2°C (0·2°C shown)

Graduation Type C Smallest scale division 0·05, 0·5 or 5°C (0·05°C shown)

*In any case not less than capillary bore diameter.

FIG. 3 PATTERN OF GRADUATION AND FIGURING OF ENCLOSED-SCALE THERMOMETERS

5.3.2 *Figuring*

5.3.2.1 The figures shall be placed immediately above the line to which they refer (*see* Fig. 3). The first two digits shall be placed on the right-hand side of the graduation lines and the first digit of hundred or its multiples may be placed on the left-hand side.

5.3.2.2 At least after every tenth smallest scale division, the graduations shall be figured on the strip on the right-hand side of the capillary tube at intervals, as shown in Fig. 3.

5.3.2.3 The digits of unit position of all numbers indicating temperature shall be roughly between two lines parallel to the bore of the capillary.

5.4 Immersion Line — In a partial immersion thermometer, a line extending both ways shall be drawn on the stem at right angles to the axis at a distance of required immersion from the bottom of the bulb of the thermometer.

5.5 Dimensions and Ranges — The thermometers shall conform to the ranges and dimensional requirements prescribed in Table 1 and Fig. 1.

5.6 Accuracy — The maximum value of calibration correction shall not exceed one smallest division of the scale of the thermometer.

6. MARKING AND PACKING

6.1 Marking — Each thermometer shall be marked permanently and legibly with the following:

a) The letter 'C' near the top of the scale;

b) Maker's name or recognized trade-mark, if any;

c) Serial number of the thermometer;

d) Schedule mark followed by letters 'TI' or 'PI', as the case may be; and

e) *Immersion line* — On partial immersion thermometers, and indication of the immersion depth for which the thermometer is calibrated, for example, ' 75 mm '.

6.2 BIS Certification Marking

The product may also be marked with Standard Mark.

6.2.1 The use of the Standard Mark is governed by the provisions of the Bureau of Indian Standards Act, 1986 and the Rules and Regulations made thereunder. The details of conditions under which the licence for the use of Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

6.2 Packing — Each thermometer shall be suitably packed as agreed to between the purchaser and the supplier.

7. TESTING AND INSPECTION

7.1 Each thermometer shall be tested for conformity to all the requirements of this specification. The accuracy test shall be carried out in accordance with IS : 6274-1971*.

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*Method of calibrating liquid-in-glass thermometers.

(*Continued from page* 2)

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